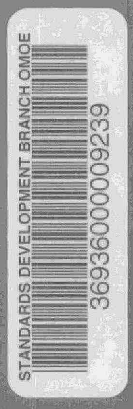


HYDROGEOLOGIC SURVEY OF WATT WARD WASTE DISPOSAL SITE

Township of Muskoka Lakes
Watt Ward
Lot 4, Concession 10

by A. A. Mellary

1974

Ontario
Ministry of the Environment

The Honourable
William G. Newman,
Minister

Everett Biggs,
Deputy Minister

cc. W. Balfour (2)
P. Cockburn
W. Ingram (1)
✓R. Hore
R. McMurray
G. Trewin
S. Watts

November 6, 1974

Mr. W. J. Dodd, Clerk,
Township of Muskoka Lakes,
Box 129,
Port Carling, Ontario.
P0B 1J0

Dear Sir:

Re: Hydrogeologic Survey of Watt Ward Waste Disposal Site, Township of Muskoka Lakes

Please find enclosed a copy of the report on the above study carried out at the request of our Municipal & Private Abatement Section on behalf of the Township of Muskoka Lakes.

The report presents an environmental impact assessment on the present practice of septic tank liquid-waste disposal at the Watt Ward Waste Disposal Site and on the potential solid waste disposal considered for this site.

It concludes that about five acres of the cleared area and additional area in the wooded part of the property is suitable for both liquid and solid wastes disposal, but that there is a shortage of suitable cover material.

It recommends the installation of observation wells to monitor the ground-water quality in the general area of the site.

The report should aid the Township in its decision to select this site for use as a potential solid waste disposal area.

Yours very truly,

P. G. Cockburn, P. Eng.
Director

Encl:

WL:jd/1-13

MINISTRY OF THE ENVIRONMENT

REPORT ON FIELD INVESTIGATIONS

DATE OF INVESTIGATION:	May 8, May 21 & 22, July 18, & 19
MATTER INVESTIGATED:	Hydrogeology of the septic tank waste disposal site, and the surrounding area and the suitability of the area for solid waste disposal: lot 4, con. 10, Watt Ward, Township of Muskoka Lakes.
AT THE REQUEST OF:	W. Balfour, District Officer, Municipal & Private Abatement, Bracebridge District Office, Central Region.
INSPECTION MADE IN COMPANY WITH:	R. Campbell and R. Hodgins
TEST DRILLING CARRIED OUT BY:	R. Hodgins and T. Sheldon
OTHER PARTIES SEEN:	W. Balfour, Ministry of the Environment D. Coates, President, Muskoka Container Service W. Dodd, Clerk, Township of Muskoka Lakes D. Grass, Ministry of the Environment W. Ingram, Mayor, Township of Muskoka Lakes Public Works Supervisor, Township of Muskoka Lakes
REPORTS TO BE SENT TO:	W. Balfour (2) P. Cockburn W. Dodd (3) R. Hore W. Ingram R. McMurray G. Trewin

REPORT BY A. A. Mellary

A. A. Mellary, P. Eng.,
Hydrogeologist

NOTE: This completed form to be attached to each report.

MINISTRY OF THE ENVIRONMENT

CENTRAL REGION

TOWNSHIP OF MUSKOKA LAKES

WATT WARD

LOT 4, CONCESSION 10

HYDROGEOLOGIC SURVEY OF SEPTIC TANK WASTE-DISPOSAL SITE AND SURROUNDING AREA AND ITS POTENTIAL FOR SOLID WASTE DISPOSAL

A. A. MELLARY

1974

MINISTRY OF THE ENVIRONMENT

HYDROGEOLOGIC SURVEY OF SEPTIC TANK WASTE-DISPOSAL SITE AND SURROUNDING AREA AND ITS POTENTIAL FOR SOLID WASTE DISPOSAL TOWNSHIP OF MUSKOKA LAKES, WATT WARD, CONCESSION 10, LOT 4

INTRODUCTION

At the request of Mr. W. Balfour, District Officer, Municipal and Private Abatement Section of the Central Region, the Technical Support Section carried out a survey of the hydrogeologic conditions of a site considered for solid waste disposal and presently used for septic tank liquid-waste disposal in existing lagoons on Lot 4, Con. 10, Watt Ward, Township of Muskoka Lakes. Ten test holes were drilled in the overburden to obtain data on the occurence and quality of ground water, type of soil and rock conditions to aid in the hydrogeologic evaluation of the site. Figure 1 shows the area under investigation and the test hole locations.

Background

Approximately five years ago, the Township of Muskoka Lakes opened a septic tank waste disposal site in a cleared area that was worked as a gravel pit previously. Presently, septic tank wastes are being disposed of into three lagoons in the southeastern corner of the clearing of the former gravel pit area. The area of the lagoons is approximately 1200 sq. feet and the total area of the clearing is estimated to be 12 acres.

In 1973, several residents in the area complained to the Ministry about alleged pollution of their wells and springs due to this waste disposal.

In the fall of 1973, Mr. R. McArthur, Hydrogeologist, with the Ministry carried out a survey to establish the validity of those complaints. The report stated that none of these complaints were valid, including that of Mr. Bilz whose well is nearest to the liquid waste lagoons. To determine the possibility of the contamination of ground water from the sewage lagoons, Mr. McArthur drilled two test holes near the lagoons to establish the presence and quality of ground water and the direction of movement. The test holes indicated that the ground water movement was easterly (toward the sewage lagoons), thus away from the residences in the area.

Site Investigation

The recent site investigation consisted of an aerial photo interpretation of the general area, and a field survey consisting of an overburden evaluation and test hole drilling program. A total of 10 test holes were drilled, at five of these soil samples were collected and water samples were obtained at four of these holes. Water and soil samples were analysed in laboratories of the Ministry. The test holes and points along the road to the lagoons and to the other pit were levelled and tied to a bench mark with an assumed elevation 100.0. Figure 1 shows the locations and elevations of the test holes and other spot elevations. Table 1 indicates the test hole and water level data including relative ground and static water level elevations, static level depths, depths and bottom elevations of test holes and whether bedrock was encountered.

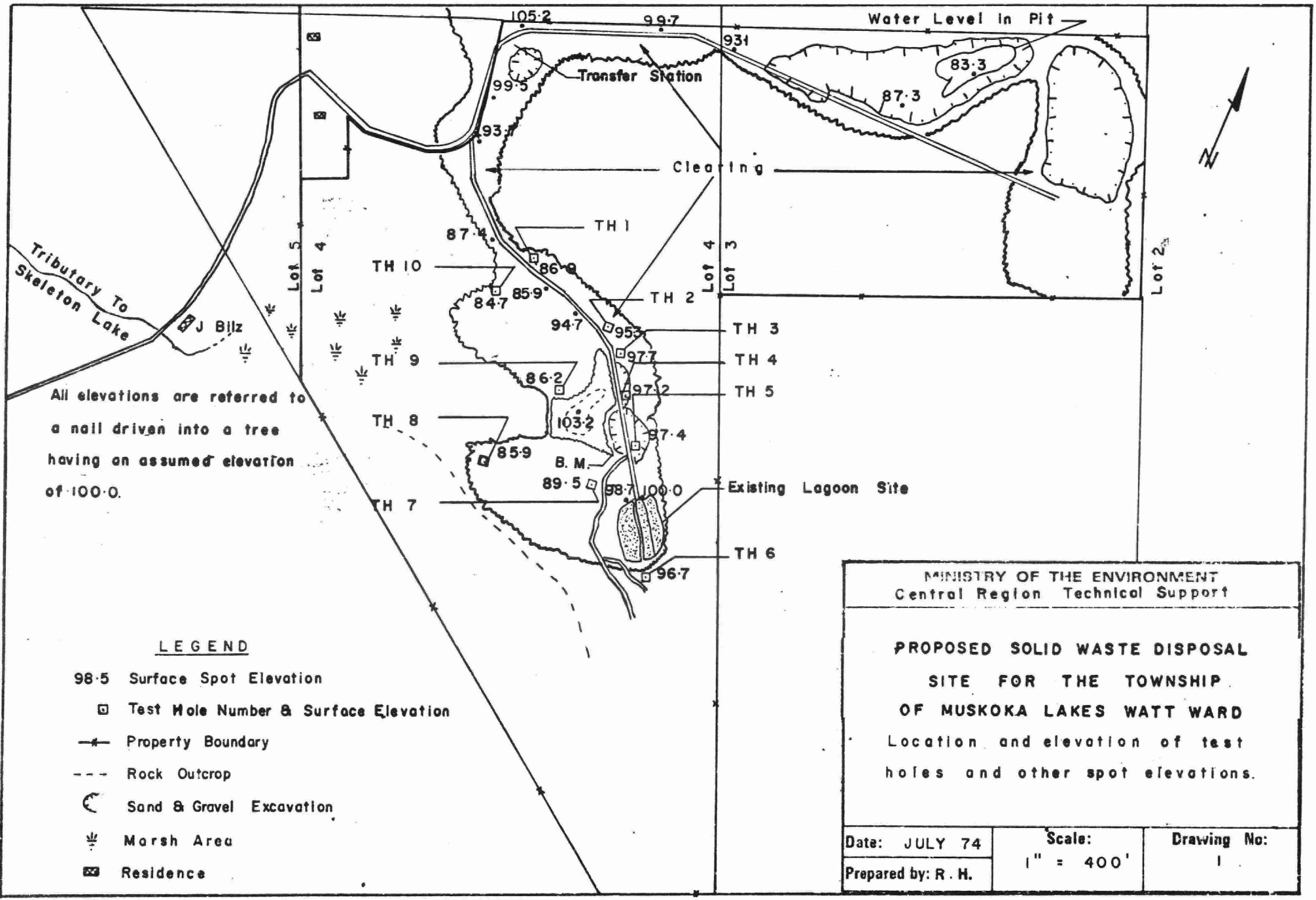

105·2
99·7
Water Level in Pit
931
Transfer Station
99·5
83·3
87·3
93·1
Clearing
TH 1
87·4
TH 10
86·9
84·7
85·9
TH 2
94·7
95·3
TH 3
97·7
TH 4
TH 9
86·2
97·2
TH 5
TH 8
103·2
87·4
85·9
B. M.
89·5
98·7
100·0
Existing Lagoon Site
TH 7
TH 6
96·7
Lot 5
Lot 4
Lot 4
Lot 3
Lot 2
Tributary To Skeleton Lake
J Bilz
All elevations are referred to a nail driven into a tree having an assumed elevation of 100·0.
LEGEND
98·5 Surface Spot Elevation
Test Hole Number & Surface Elevation
Property Boundary
Rock Outcrop
Sand & Gravel Excavation
Marsh Area
Residence
MINISTRY OF THE ENVIRONMENT
Central Region Technical Support
PROPOSED SOLID WASTE DISPOSAL SITE FOR THE TOWNSHIP OF MUSKOKA LAKES WATT WARD
Location and elevation of test holes and other spot elevations.
Date: JULY 74
Prepared by: R. H.
Scale: 1" = 400'
Drawing No: 1

TABLE 1. TEST HOLE AND WATER LEVEL DATA

Test Hole Number	Ground Elevation** (feet)	Depths and Bottom Elevations on May 22/74 Depth (feet)	Elev.	Depths and Bottom Elevations on July 18/74 Depth (feet)	Elev.	Static Water Levels on May 22/74 Depth (feet)	Elev.	Static Water Levels on July 18/74 Depth (feet)	Elev.
1	86.9	15.0	71.9	-	-	6.4	80.5	-	-
2	95.3	-	-	14.1R	81.2R	7.6*	87.7*	10.7	84.6
3	97.7	-	-	16.0R	81.7R	8.3*	89.4*	11.4	86.3
4	97.2	-	-	17.0	80.2	7.2*	90.0*	10.3	86.9
5	97.4	15.0	82.4	20.0R	77.4R	11.8	85.6	13.7	83.7
6	96.7	15.0	81.7	21.0	75.7	dry		dry	
7	89.5	15.0	74.5	19.0R	70.5R	12.4	77.1	15.5	74.0
8	85.9	4.8	81.1	7.5	78.4	1.8	84.1	5.0	80.9
9	86.2	-	-	8.0	78.2	3.6*	82.6*	6.7	79.5
10	84.7	-	-	5.9	78.8	1.2*	83.5*	4.3	80.4

R - Bedrock was encountered

* - Estimated figure; static level in May was 3.1 ft. higher than in July.

** - All elevations are referred to a nail in a tree, having an assumed elevation of 100.00.

Tables 2 & 3 show the soil and water quality analysis data respectively.

Geology

The Precambrian bedrock described as granitized hornblende migmatite according to Map 2118 of the Ontario Department of Mines; controls the geology and topography of the area. This map indicates the strike of bedrock in a generally north and south direction with an easterly dip of 20 degrees. This delineation of the bedrock is clearly noticeable from the air photos. The bedrock in many areas is covered by sand and fine gravel probably of ice-contact origin. These materials were likely deposited near the end of the last glaciation of the Pleistocene period.

The bedrock outcrops near the middle and also to the southwest of the southern part of the study area where it forms a relatively high ridge, (**Figure 1**). The bedrock surface is generally quite irregular, consequently the thickness of the overburden is variable. Most of the coarse sediments in the investigated area have been mined, the present soil consist mainly of sandy silt or fine sand.

In four test holes bedrock was encountered. The bedrock outcrop and surrounding area is the topographic high in the cleared area, the land slopes downward to the west, both north and south of this outcrop.

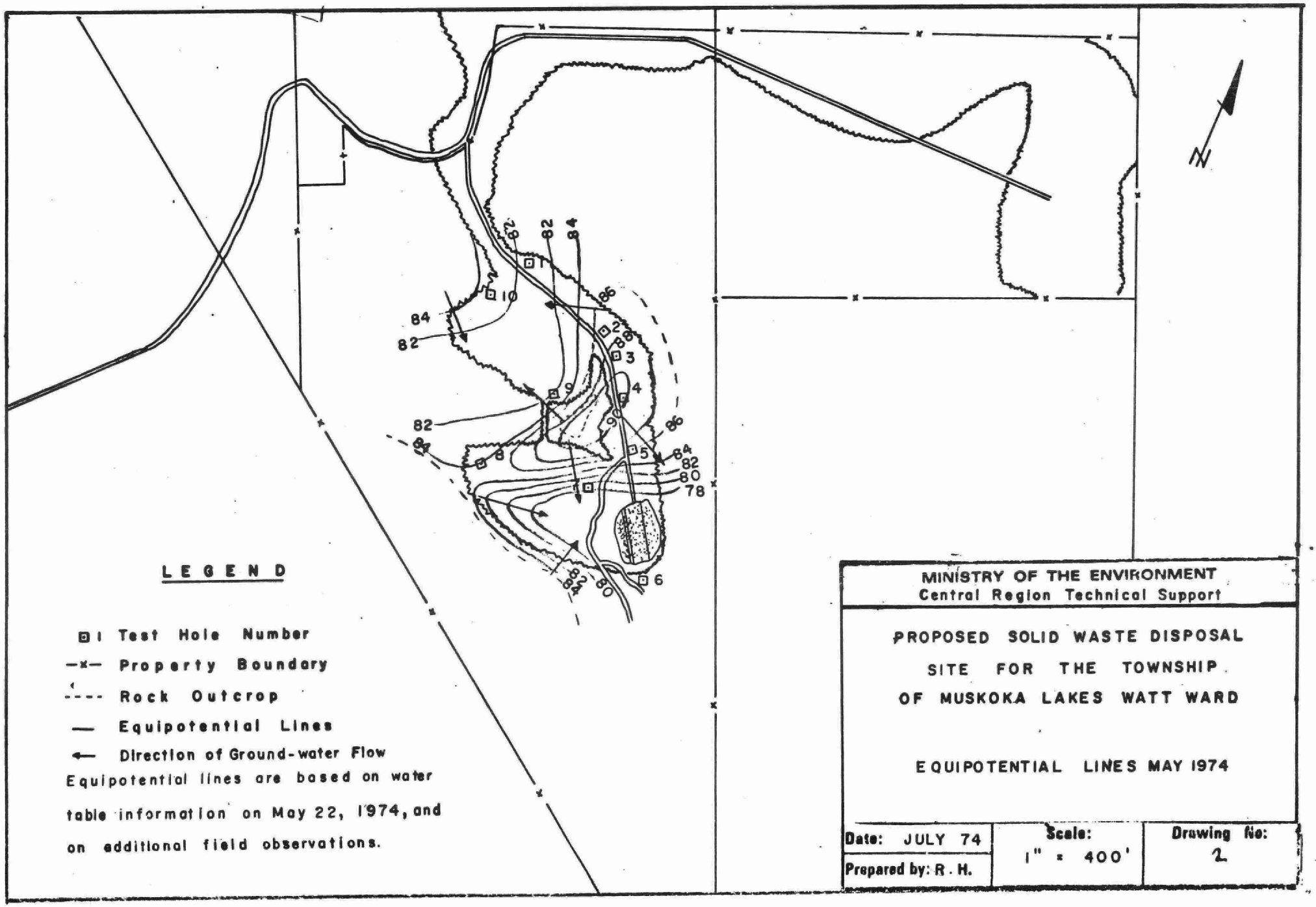
The marshy area northwest of the outcrop, just west of the clearing is part of the head waters of the small stream flowing through Mr. Bilz's property.

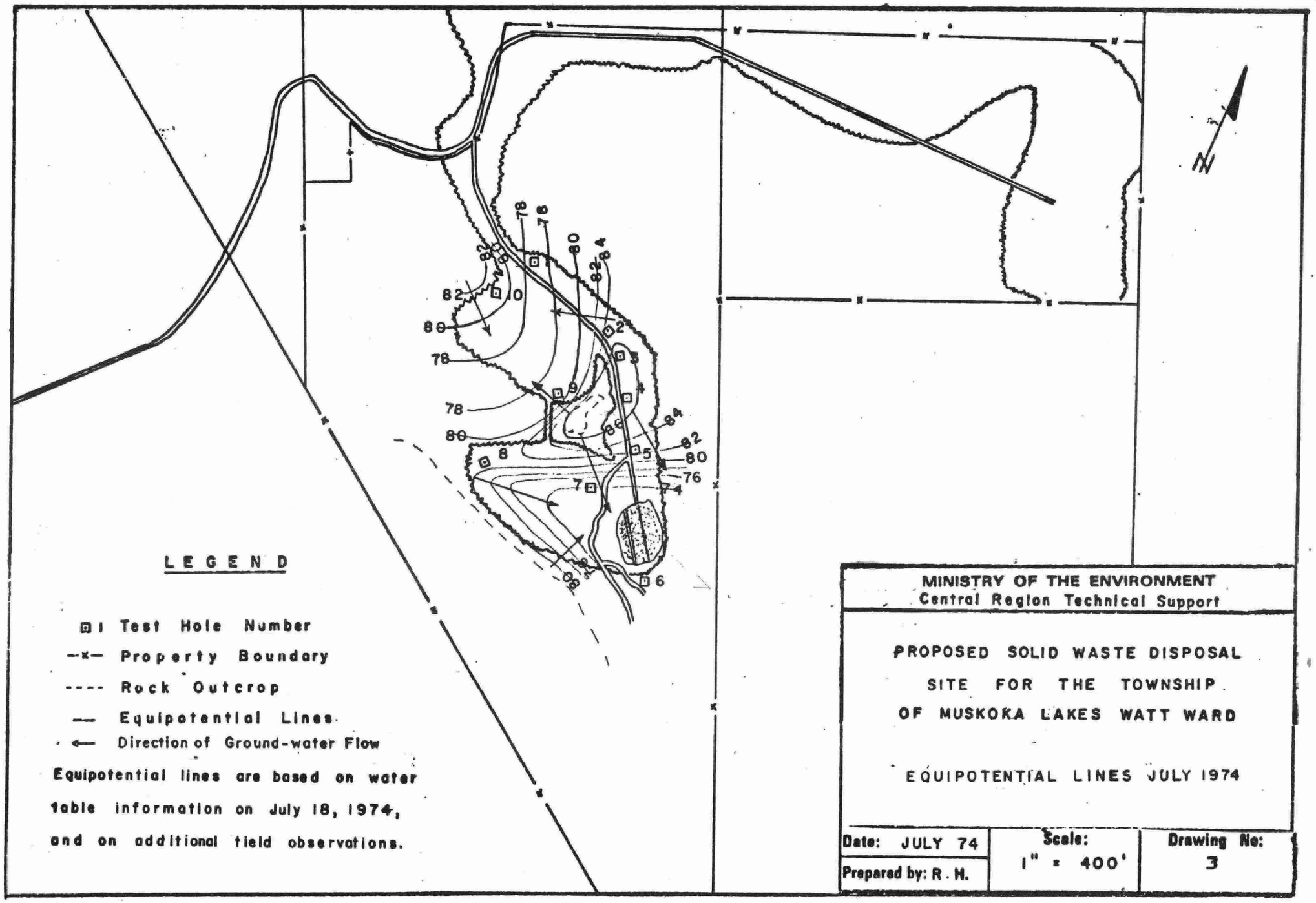
Ground Water

Ground water was encountered in nine test holes. Figure 2 & 3 indicate the potentiometric surface of the ground water and the direction of ground-water flow in May and July respectively. Five test holes were drilled in May and another five in July. Four test holes were redrilled in July to determine correlation between static levels in May and July. The static levels were about 3.1 feet higher in May than in July.

The two potentiometric maps show that the ground-water flow is governed by the bedrock outcrop in the middle of the site which seems to act as a ground water divide. South of the site the direction of the flow is southeasterly with an approximately 6 per cent gradient near the outcrop and a probably lesser gradient at the east and south side of the lagoons. No ground water was encountered down to a depth of 21 feet at test hole 6, just south of the lagoons. North of the outcrop the flow of the ground water is northwesterly. In the northeastern part of the site the flow is westerly and northwesterly and in the northwestern part of the site it is southerly.

Figure 4 shows the depth to the static level in each test hole in May.


N
LEGEND
Test Hole Number
Property Boundary
Rock Outcrop
Equipotential Lines
Direction of Ground-water Flow
Equipotential lines are based on water table information on May 22, 1974, and on additional field observations.
MINISTRY OF THE ENVIRONMENT
Central Region Technical Support
PROPOSED SOLID WASTE DISPOSAL SITE FOR THE TOWNSHIP OF MUSKOKA LAKES WATT WARD
EQUIPOTENTIAL LINES MAY 1974
Date: JULY 74
Prepared by: R. H.
Scale: 1" = 400'
Drawing No: 2



LEGEND

- ⊡ 1 Test Hole Number
- —x— Property Boundary
- ---- Rock Outcrop
- — Equipotential Lines
- ← Direction of Ground-water Flow

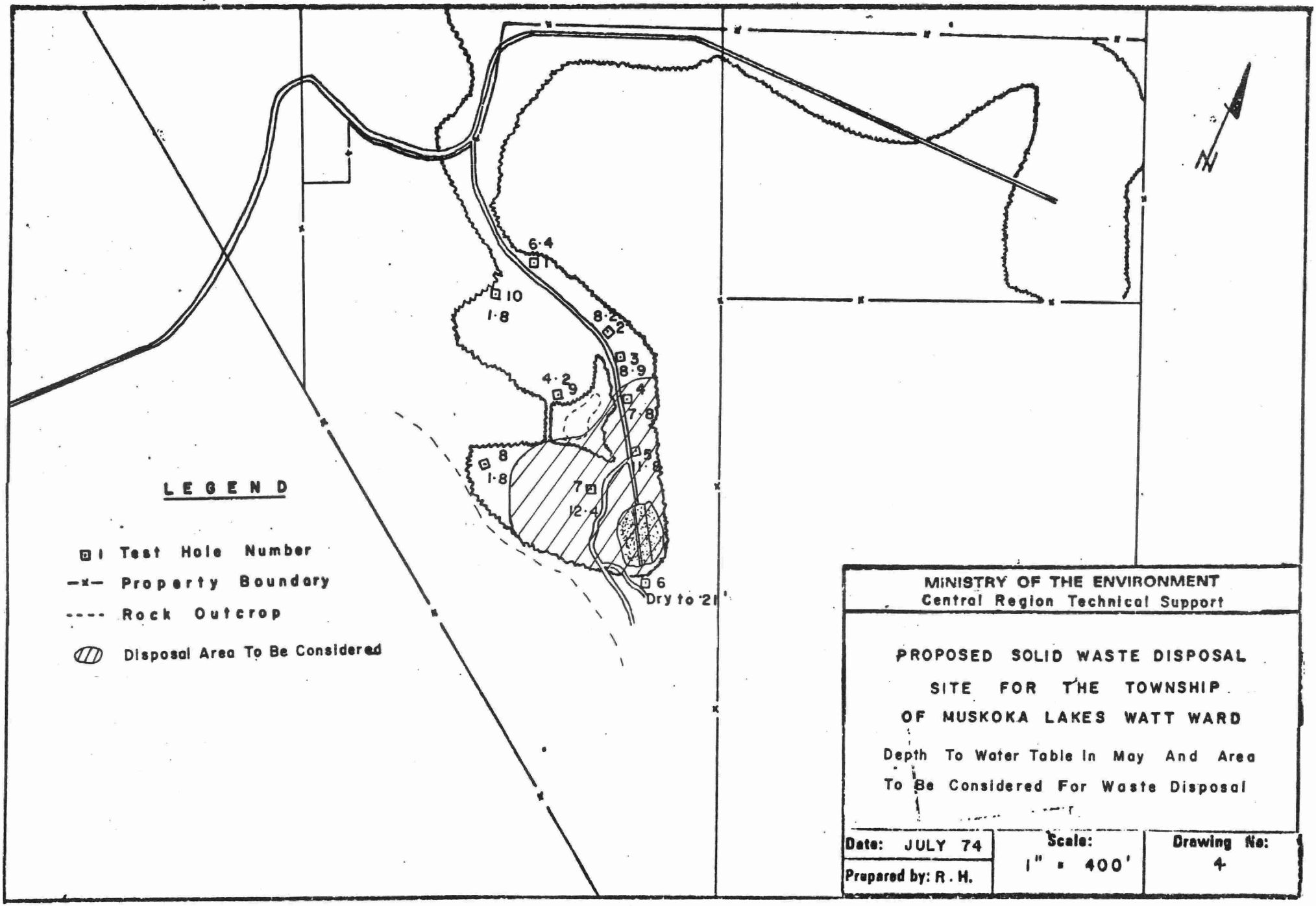
Equipotential lines are based on water table information on July 18, 1974, and on additional field observations.

MINISTRY OF THE ENVIRONMENT
Central Region Technical Support

PROPOSED SOLID WASTE DISPOSAL SITE FOR THE TOWNSHIP OF MUSKOKA LAKES WATT WARD

EQUIPOTENTIAL LINES JULY 1974

Date: JULY 74	Scale: 1" = 400'	Drawing No: 3
Prepared by: R. H.		


6·4
1
10
1·8
8·2
2
3
8·9
4·2
9
4
7·8
5
1·8
8
1·8
7
12·4
6
Dry to 21'
N
LEGEND
1 Test Hole Number
Property Boundary
Rock Outcrop
Disposal Area To Be Considered
MINISTRY OF THE ENVIRONMENT
Central Region Technical Support
PROPOSED SOLID WASTE DISPOSAL
SITE FOR THE TOWNSHIP
OF MUSKOKA LAKES WATT WARD
Depth To Water Table In May And Area
To Be Considered For Waste Disposal
Date: JULY 74
Prepared by: R. H.
Scale:
1" = 400'
Drawing No:
4

These levels are likely close to the highest static levels at the site since the water table is usually the highest after spring break-up. The water table seems to be the deepest in the area near the lagoons and also deep in the area east and north-east of the outcrop, but it is shallow in the western most part of the clearing both south and north of the outcrop.

In May the water table was estimated to be at an elevation below 76 feet which was at least 20 feet below the bottom elevation of the lower western lagoon.

The annual precipitation at the site is estimated to be about 38 inches based on long-term precipitation records at nearby weather stations. The topographic setting of the area permits little surface runoff especially in the southern part of the site. It is estimated that the annual recharge rate would be in excess of 15 per cent, most of it taking place in the spring. Water levels dropped an average of 3 feet from May to July which indicate that the annual water level fluctuations could be very significant.

Soil Test Results

Eight samples from five test holes were analysed for grain size distribution. The graphs of the grain size analyses are attached. On the basis of these analyses the permeability was estimated for these locations at the depths sampled. Table 2 summarizes the soil test data. The permeability south of the outcrop was found to range from 11.0×10^{-4} cm/sec to 1.7×10^{-4} cm/sec, with an average of 4.3×10^{-4} cm/sec, but in test hole 1 at the northern limit of the study area, the permeability was more than 10 times as high. The calculation of permeability is

TABLE 2. SOIL TEST DATA

Test Hole Number	Depth to Water Table on May 22/74 (feet)	Sample			Permeability (k) (cm/sec)
		Number	Descripton	Depth (feet)	
1	6.4	1	silty fine sand	3-6	3.1×10^{-3}
1	6.4	2	fine sand	7-9	8.1×10^{-3}
5	11.8	1	silty sand	1-3	3.2×10^{-4}
5	11.8	2	sandy silt	20	4.4×10^{-4}
6	dry	1	fine sand	6-9	1.1×10^{-4}
7	12.4	1	sandy silt	3-6	1.7×10^{-4}
7	12.4	2	sandy silt	15	3.2×10^{-4}
8	1.8	1	sandy silt	3-6	2.2×10^{-4}

described in Appendix A and the grain size distribution graphs are included in Appendix B.

Ground Water Quality

The chemical quality of the water sampled from four test holes was found to be very good. The results of the water quality analysis are listed in Table 3. The high iron levels are due to the very high silt content of the water samples. These samples had not been filtered at the time of collection. The results of the chemical analyses performed on the water samples show that the other constituents tested for, were well below the permissible Ministry criteria for drinking water, even for the sample taken from test hole 7 located near the lagoons but situated upgradient from them.

The analysis results of the sample collected at test hole 1 indicate the presence of zinc and lead in the ground water. As was indicated before, there is a ground water divide between the lagoons and test hole 1. There was no zinc and lead found in the samples obtained from the test holes closer to the lagoons; therefore, it must be assumed that the presence of these metals is natural in test hole 1.

Environmental Impact Considerations

The potential for sewage lagoons and other leachate producing landfill operation to pollute ground water in the surrounding area was evaluated using the method developed by H. E. LeGrand (1963).

MINISTRY OF THE ENVIRONMENT

Table 3. Summary of Water Analyses

Prepared by:

Source and Number	Location	Date Sampled	pH	BOD	Total Hardness as $CaCO_3$ (ppm)	Alkalinity as $CaCO_3$ (ppm)	Specific Conductance mmhos at 25°C	Chemical Constituents in parts per million (ppm)													
								Chloride (Cl)	Sulphate (SO_4)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potasium (K)	Nitrogen as N				Phosphorus as P			
															Free Ammonia	Total Kjeldahl	Nitrite	Nitrate	Tot.	Sol.		
Test Hole 1		May 22/71	7.4		96	58	118	3	20	1650	27	6	2	1.0	<.1	2.4	<.02	<.2	.58	<.02		
Test Hole 5		"	7.5		18	10	40	2	5	2.1	7	1	1	1.3	<.1	.1	.02	.80	.60	.04		
Test Hole 7		"	7.1		56	38	116	8	5	94	16	3	4	.8	<.1	.9	.04	<.2	.50	<.02		
Test Hole 8		"	7.1		68	67	92	3	9	600	26	1	1	0.7	<.1	2.6	.02	<.2	1.7	.02		

		Bicarbonate Alkalinity	Arsenic as As	Zinc as Zn	Lead as Pb	Total Dissolved Solids
Test Hole 1		58	/	2.1	.61	101
Test Hole 5		10	.01	/	/	35
Test Hole 7		38	/	/	/	66
Test Hole 8		67	/	/	/	89

The above method has practical application in environmental impact evaluation on ground water contamination potential of waste disposal presently taking place (septic tank wastes) and possible future municipal solid waste disposal. It considers water table conditions, sorption and permeability of the overburden material, water table gradient and distance to point of use.

Based on this method the potential for ground water pollution downgradient from the disposal site was estimated to be 300 ft., while upgradient, the estimated distance for pollution was found to be 100 feet. This evaluation was based on a minimum depth of 10 feet of unsaturated sediment between the refuse base and the water table surface, the type of soil found on the site, flow gradient, permeability and the presence of at least 20 feet of sediments above the bedrock. Considering the above factors the potential for ground water pollution beyond the aforementioned distances is "very improbable".

As presented before, little surface water runoff is expected from the proposed disposal area, therefore the possibility of contamination of the surface water in the general area is also very improbable. Surface water may pond in the low lying southwestern corner of the proposed disposal site until infiltrated or evaporated.

Conclusions & Recommendations

1) The cleared area south of the outcrop with the exception of the low-lying western portion of that area is suitable for both liquid and solid wastes disposal.

2) The acceptable waste disposal site has the following drawbacks:

a. The cleared site suitable for waste disposal is about five acres in size.

b. There is a lack (or shortage) of suitable impermeable cover material in the immediate area.

c. The site is not strategically located in relation to existing population centres in the township.

3) The waste disposal area could likely be extended into the wooded area lying southeast of the cleared area found acceptable for waste disposal.

4) It is recommended that the municipality install three monitoring wells, one north, one east, and one south of the limits of the area found acceptable for waste disposal, whether the site will be used for both solid and septic tank waste disposal or only for septic tank waste disposal.

5) If the area north of the outcrop is to be considered for waste disposal, design of further engineering measures to control the liquid and solid waste disposal would be necessary.

Prepared by:

A. A. Mellary, P. Eng.
Water Resources Assessment
Technical Support Section
Central Region

AAM:lj

Attachment -

Approved by:

W. Lammers, Chief
Water Resources Assessment
Technical Support Section
Central Region

References:

LeGrand, H. E.

1963: System for Evaluation of Contamination Potential of some waste disposal sites; Journal American Water Works Association, Vol. 56, No. 8, Aug. 1964

McArthur, R. E.

1974: Township of Muskoka Lakes (Watt Ward), Alleged Contamination of Private Wells emunating from a municipal sewage disposal site; Ontario Ministry of the Environment.

Ontario Department of Mines.

1963: Map 2118 Parry Sound - Huntsville Area.

Peck, R. B., Hanson, W. E., and Thornburn, T. H.

1959: Foundation Engineering; John Wiley & Sons, Inc.

APPENDIX A

Calculation of Permeability

From the D_{10} value of each grain size distribution graph, the permeability at the sampled locations was estimated according to equation of Allen Hazen:

$$k = C\, D_{10}^2$$

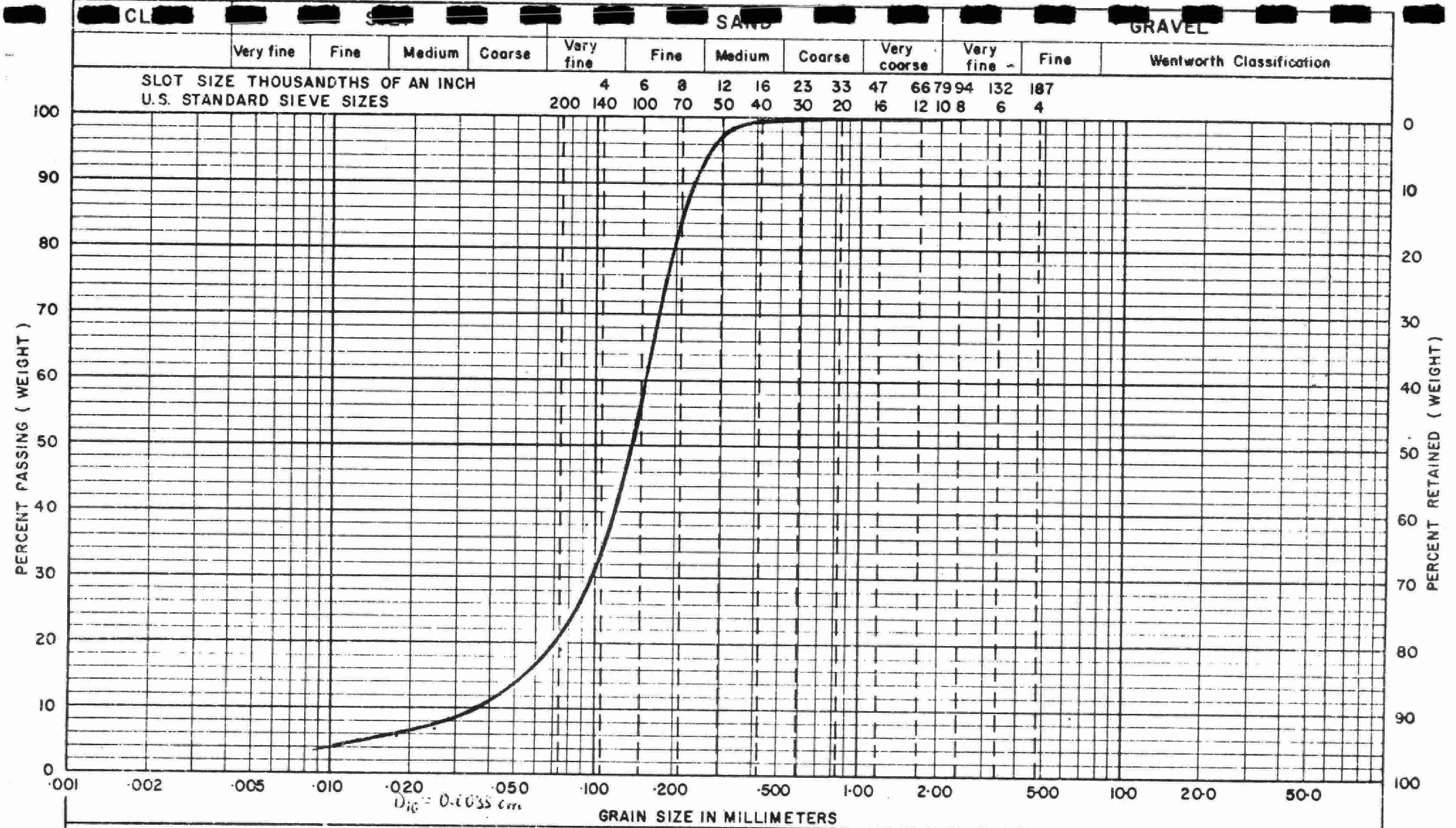
Where k = permeability, cm/sec

C = approximately 100/cm sec

D_{10} = effective grain size, cm

APPENDIX B

Grain Size Distribution Graphs.



NOTES

Township of Baskatong Lakes.

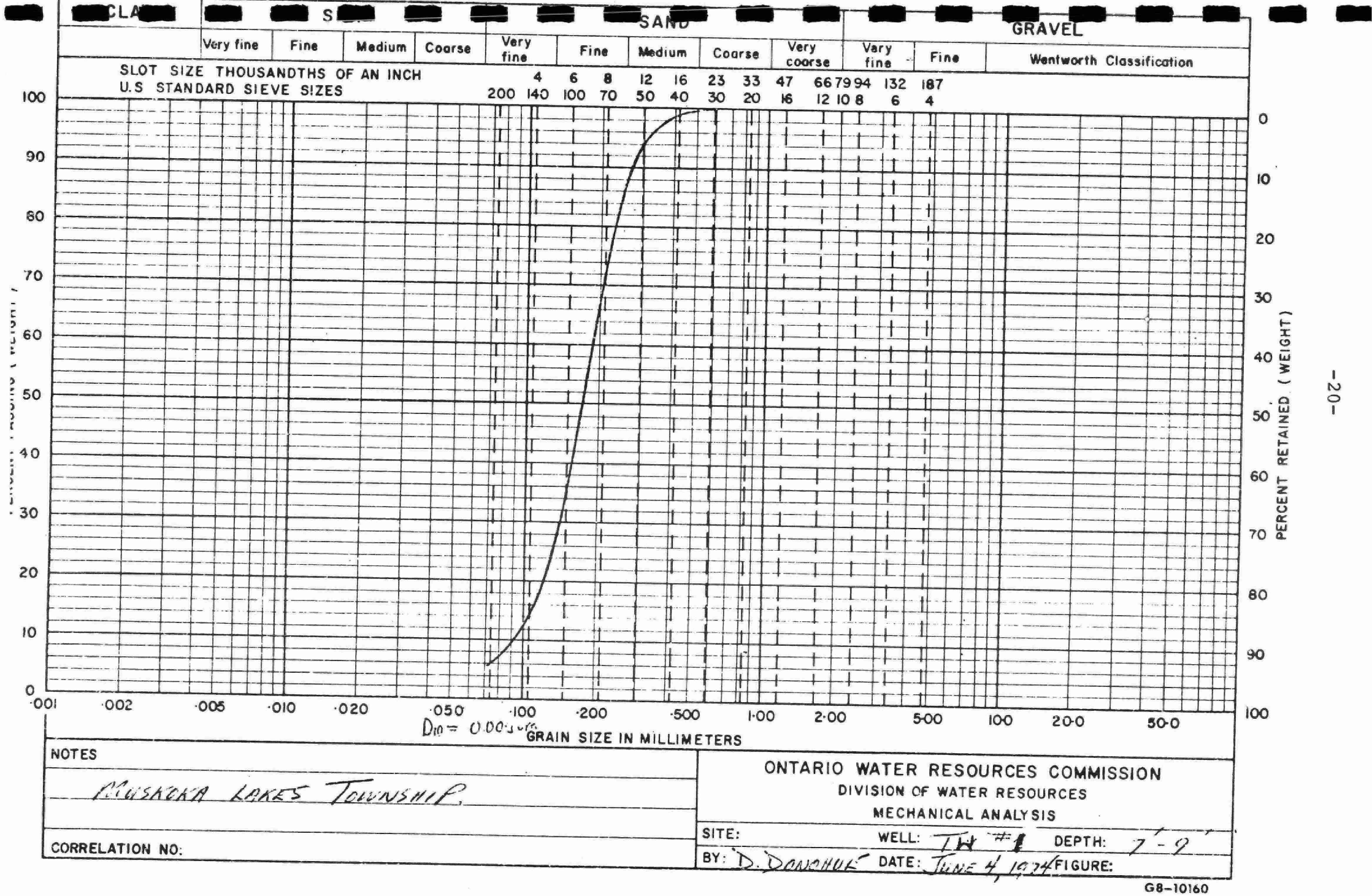
CORRELATION NO:

ONTARIO WATER RESOURCES COMMISSION
DIVISION OF WATER RESOURCES
MECHANICAL ANALYSIS

SITE: WELL: TH #1 DEPTH: 3'-6'

BY: D. Donohue DATE: June 20, 1974 FIGURE:

G8-10160



NOTES

MUSKOKA LAKES TOWNSHIP.

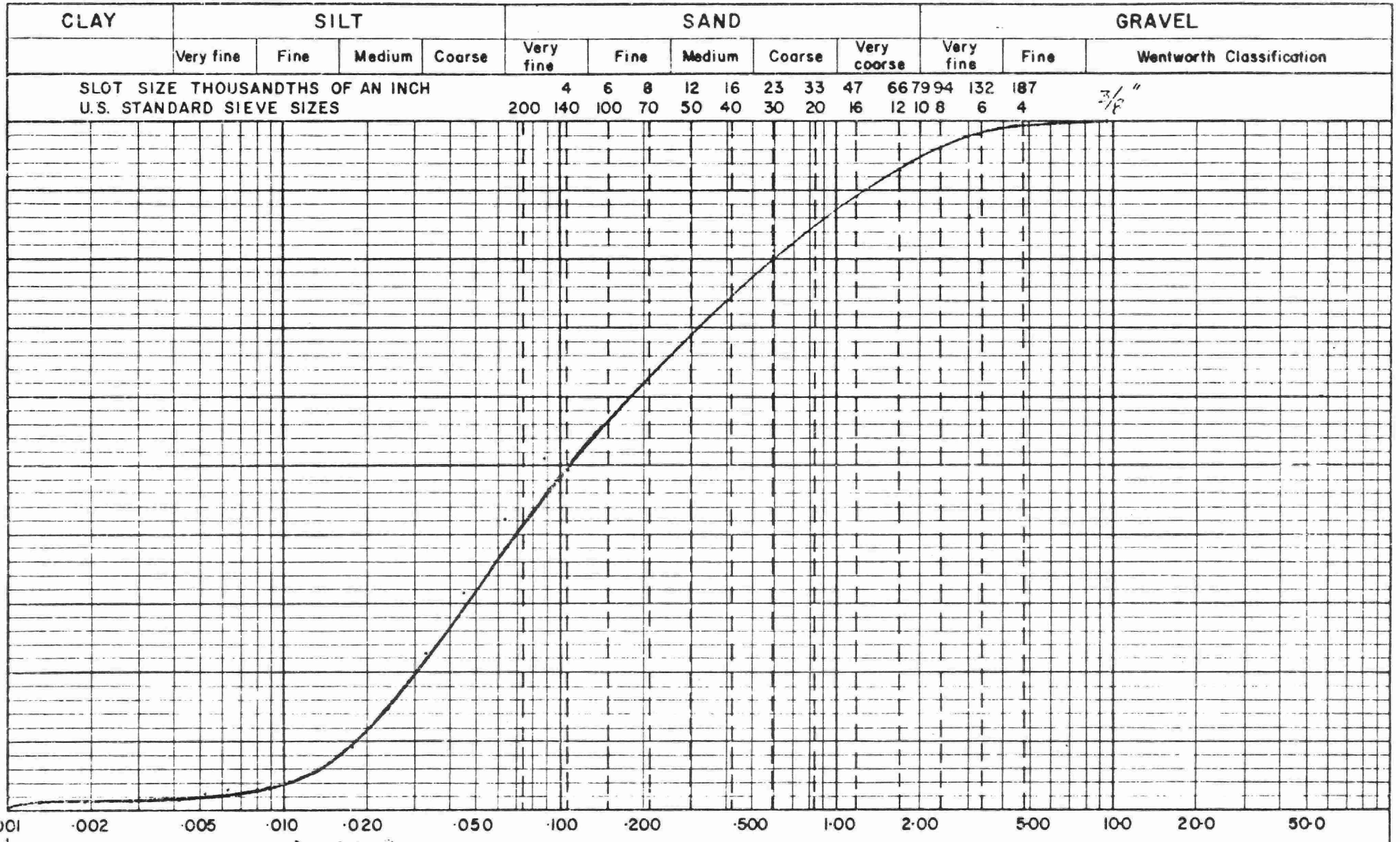
CORRELATION NO:

ONTARIO WATER RESOURCES COMMISSION
DIVISION OF WATER RESOURCES
MECHANICAL ANALYSIS

SITE: WELL: TH #1 DEPTH: 7 - 9'

BY: D. DONOHUE DATE: JUNE 4, 1974 FIGURE:

G8-10160



NOTES

MUSKOKA LAKES TOWNSHIP

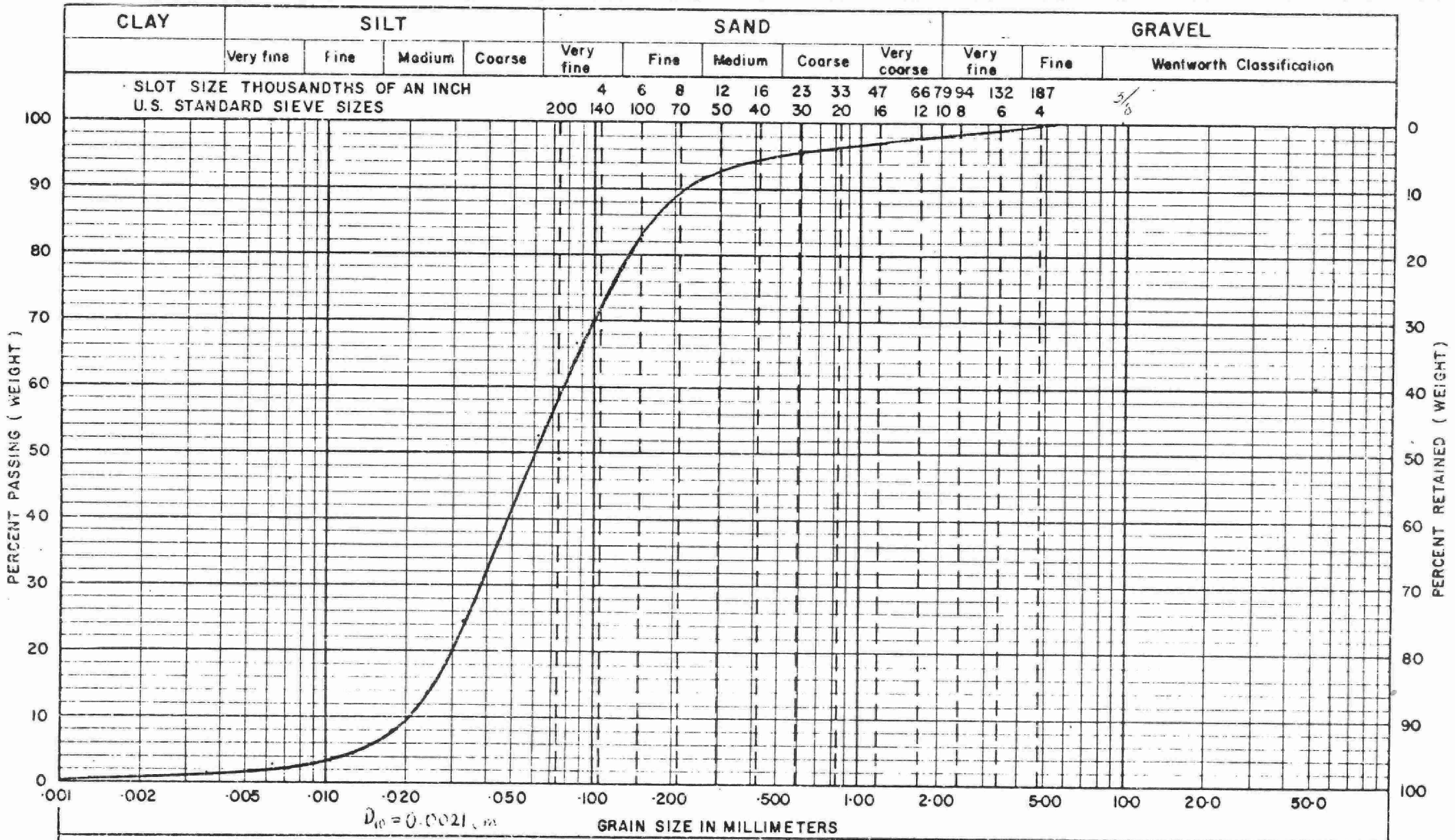
CORRELATION NO:

ONTARIO WATER RESOURCES COMMISSION
DIVISION OF WATER RESOURCES
MECHANICAL ANALYSIS

SITE: WELL: TW 5 DEPTH: 1 - 3'

BY: D. DONOHUE DATE: JUNE 5, 1974 FIGURE:

G8-10160



NOTES

E. of SKOKA LAKES Township

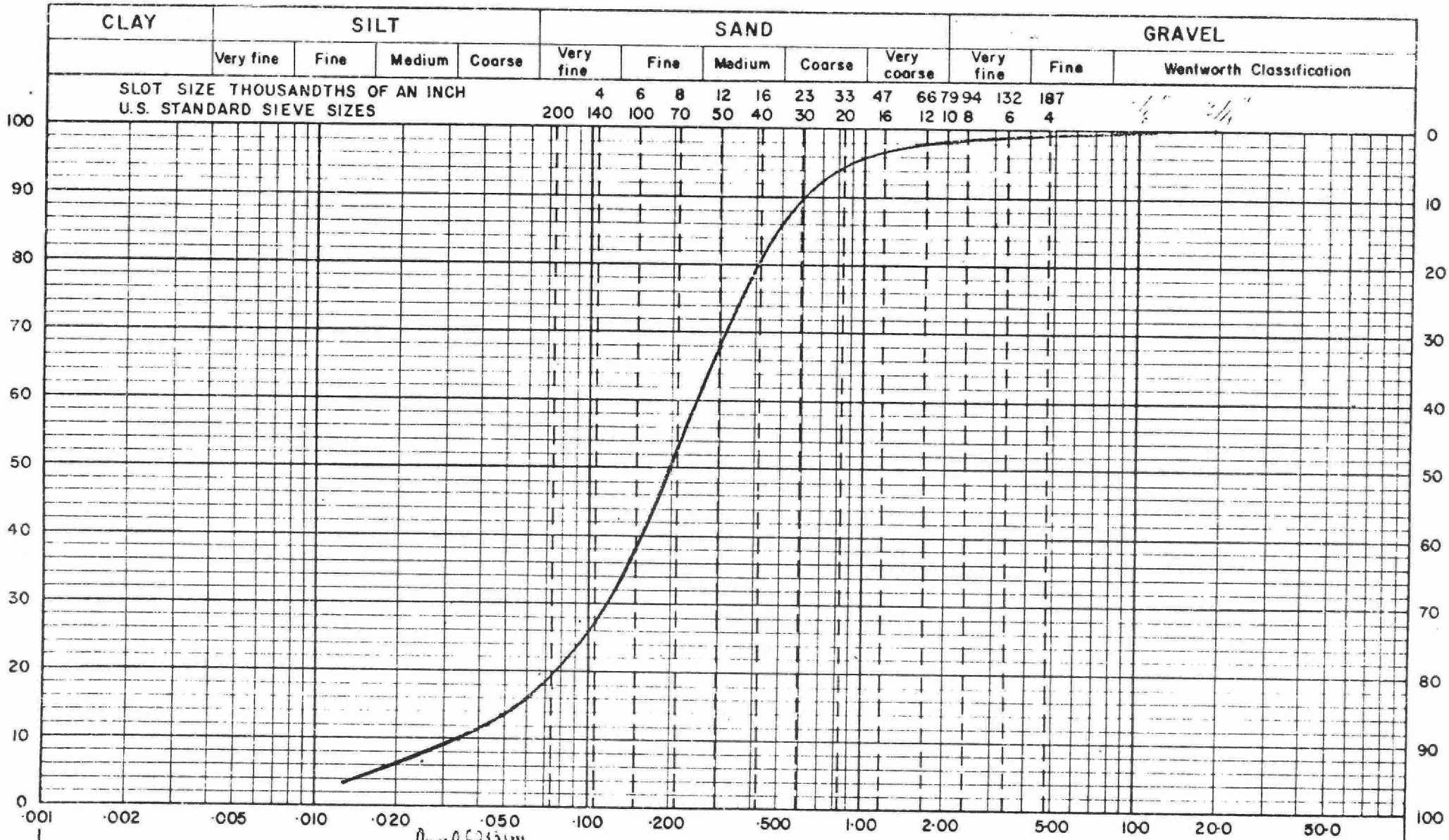
CORRELATION NO:

ONTARIO WATER RESOURCES COMMISSION
DIVISION OF WATER RESOURCES
MECHANICAL ANALYSIS

SITE: WELL: TH # 5 DEPTH: bottom 30'

BY: T. DONOHUE DATE: JUNE 5, 1972 FIGURE:

G6-10160



NOTES

Township of Muskoka Lakes

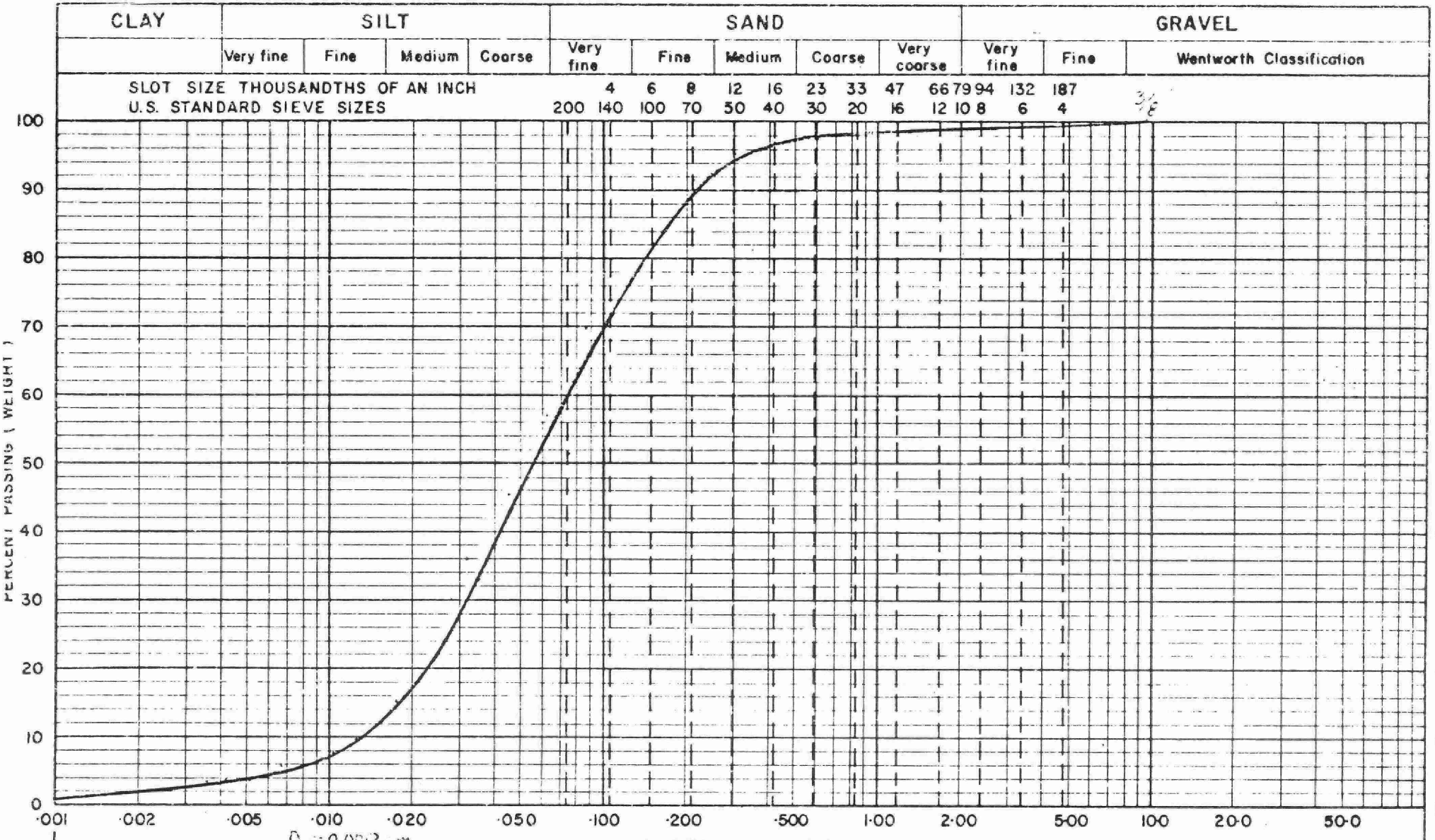
CORRELATION NO:

ONTARIO WATER RESOURCES COMMISSION
DIVISION OF WATER RESOURCES
MECHANICAL ANALYSIS

SITE: WELL: TH 6 DEPTH: 6 - 8'

BY: D. Donohue DATE: Jan. 20, 1972 FIGURE:

G8-10160



NOTES

MUSKOKA LAKES TOWNSHIP

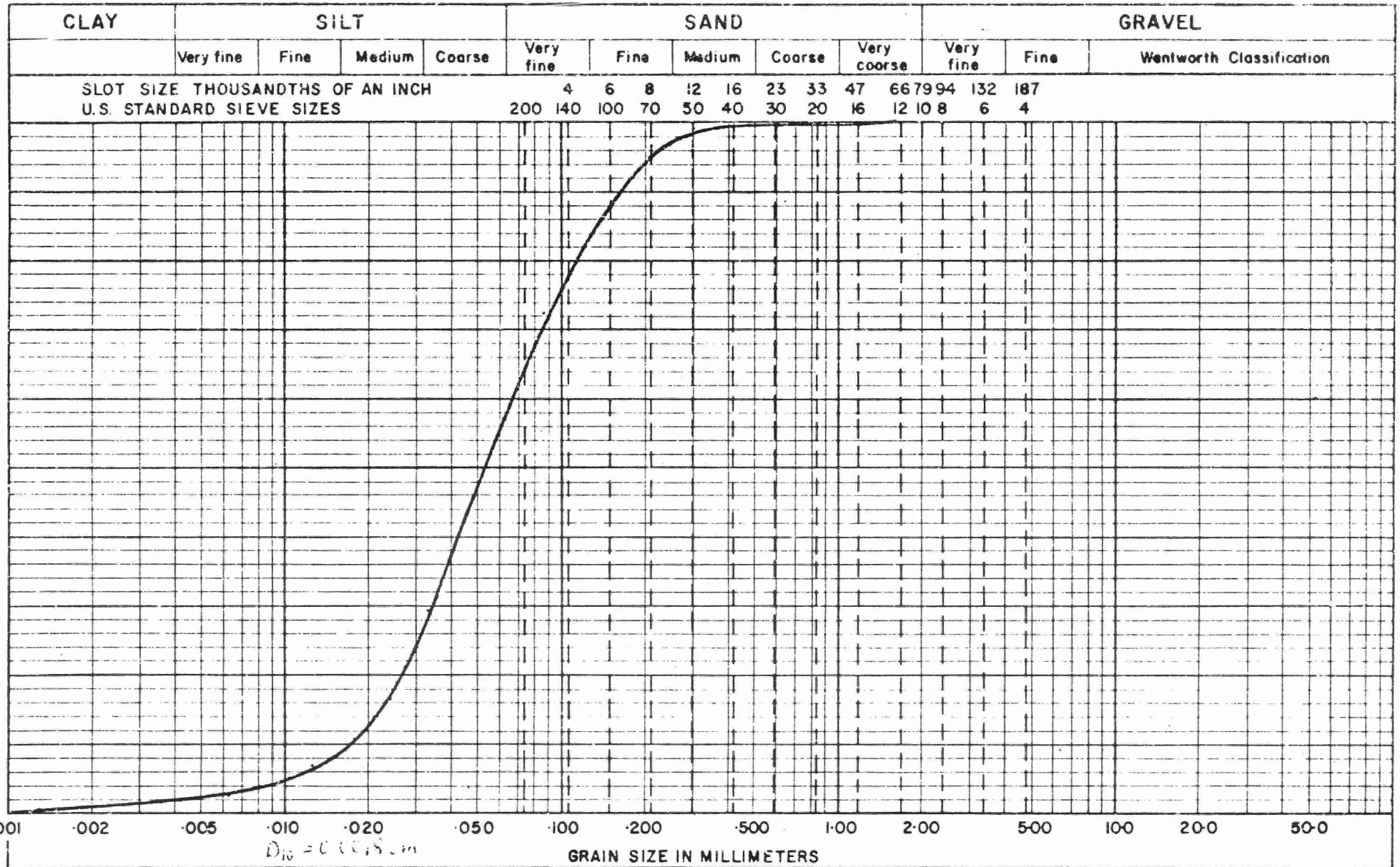
CORRELATION NO:

ONTARIO WATER RESOURCES COMMISSION
DIVISION OF WATER RESOURCES
MECHANICAL ANALYSIS

SITE: WELL: TH # 3 DEPTH: 3'-6"

BY: D. DONCHUK DATE: JUNE 5, 1974 FIGURE:

G8-10160



NOTES

MUSKOKA LAKES TOWNSHIP

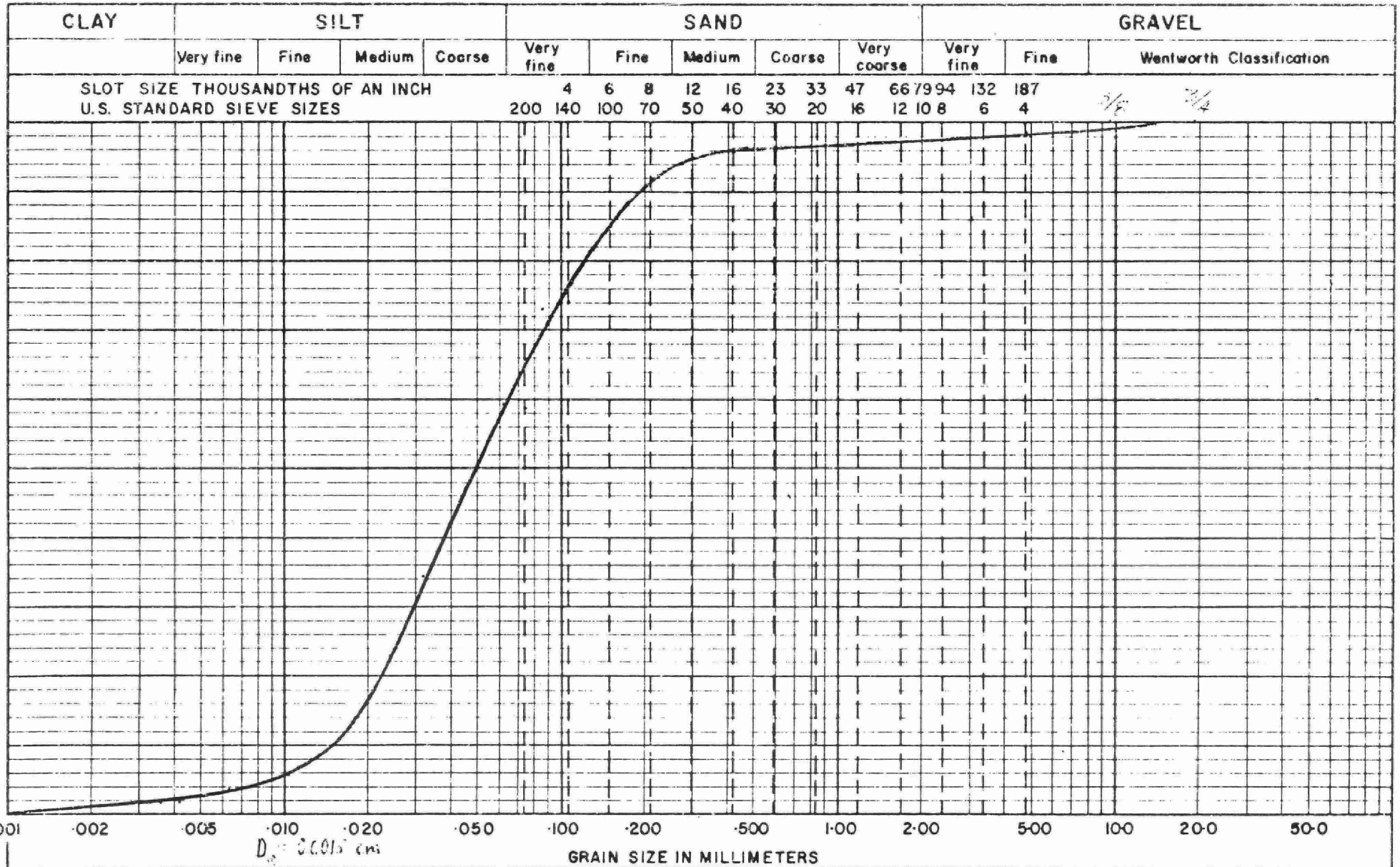
CORRELATION NO:

ONTARIO WATER RESOURCES COMMISSION
DIVISION OF WATER RESOURCES
MECHANICAL ANALYSIS

SITE: WELL: THEZ DEPTH: 15

BY: D. DONCHUE DATE: JUNE 5, 1972 FIGURE:

G8-10160



NOTES

MUSKOKA LAKE TOWNSHIP

CORRELATION NO:

ONTARIO WATER RESOURCES COMMISSION
DIVISION OF WATER RESOURCES
MECHANICAL ANALYSIS

SITE: WELL: TH # 8 DEPTH: 2 - 6'

BY: D. DONOHUE DATE: JUNE 5, 1974 FIGURE:

G8-10160